GRANTS FOR RE- AND NEWLIGHTING IN FLANDERS: A NEW APPROACH

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ABSTRACT

For a long time, Flemish companies and local authorities which realize energy efficient lighting solutions have the opportunity to get grants from the Flemish government. However, the conditions and the amount of the grant have been changed substantially since January 2010. The new approach is proposed and illustrated by two practical examples.

Keywords: Energy efficient lighting, Lighting, Normalized Power Density, Utilance, Grants

1. INTRODUCTION - WHY CHANGING?

For many years, the Flemish government provides grants for energy efficient lighting solutions. To get a subsidy for a re- or new lighting project, the normalized power density *NPD* has been used for years as the evaluation criterion. The *NPD* of a lighting installation relates the electrical power for lighting to the mean maintained illuminance on a reference plane and to the overall floor area and is typically expressed in *W*/(*m*²·100 *lx*). As an example, a classroom of 10m by 10m with an installed light power load of 1 *kW* and a maintained illuminance value of 555 *lx* on the reference plane has an *NPD* value of 1,8 W/(*m*²·100*lx*). Until the end of 2009, the maximum *NPD* value to be considered for grant allocation was 2 *W*/(*m*²·100 *lx*) for offices and industrial buildings and 2,5 *W*/(*m*²·100*lx*) for sports halls and swimming pools. The limit values were based on everyday experience. Obviously, the *NPD* is the first and significant measure for the energy consumption although the adopted lighting controls (dimming, presence detection, etc.) will also have a major contribution to the overall power consumption. Nevertheless, the lower the *NPD* the more efficient the lighting installation.

NPD values are only applicable for areas where a uniform illuminance is required over a task area approximately equal to or parallel with the floor, as this is commonly the case for open plan offices. It is obvious that in shops, storehouses, classrooms and many other situations, the task areas can be completely different from the floor area. In these cases, *NPD* values referenced to the floor area are by no means relevant any more. For this reason, a lot of energy efficient lighting solutions were not considered for grants. This has forced the Flemish Energy Agency to revise the conditions for grant allocation.

2. NEW EVALUATION METHOD

From 2010 on, the assignment of grants in Flanders is based on a new evaluation method which is proposed in [1] and recently extended in [2]. The alternative approach to assess the energy efficiency of an indoor lighting installation formulates a maximum target value for the installed electrical power P_T (unit *W*) instead of a maximum *NPD* value (unit W/(*m*²·100*lx*).

The starting point of the alternative method is the illumination of task areas. A task area is any surface for which a minimal illuminance has to be guaranteed. The orientation of the task areas is arbitrary. The lighting designer, in consensus with the client, determines the task area(s) and the corresponding illuminance values. Those values can be inspired on the European standard EN12464-1 [3] in which specific task areas and corresponding illuminance values are defined for many indoor applications.Moreover, the standard [3] is currently under revision and stipulates illuminance values on non-standard areas (f.i. walls) to be guaranteed.

2.1 Power load of an interior lighting installation

The power load P_{inst} of an interior lighting installation is function of the efficiency of the lamp-ballast combination n_{sys}, the efficiency of the luminaires LOR, the maintenance factor MF, the utilance U (which is the efficiency of directing the luminous flux from the luminaires to the task areas), the size of

the task areas and the required illuminance values:

$$P_{inst} = \frac{\sum_i \bar{E}_{TA,i}^{fin} \cdot A_{TA,i}}{MF \cdot U \cdot LOR \cdot \eta_{sys}} \quad (1)$$

2.2 Definition and classification of task areas

In order to formulate an analytical expression for the utilance in a very simple but general way, a classification of the task areas is needed. A task area is any surface for which a minimal illuminance has to be guaranteed. The lighting designer determines the task area(s) and the corresponding illuminance values [2-3]. One can distinguish three classes of task areas:

- Task area(s) *type a*: a task area coincident with the *floor* or a transparent calculation surface parallel with the floor *(e.g.* open plan office);
- Task area(s) *type b*: a task area coincident with the *wall(s)* or a transparent calculation surface parallel with the wall(s). A typical example is a wall in a museum;
- Task area(s) *type c*: a task area coincident with *additional furniture*. A typical example are the many vertical task areas in a storehouse.

2.3 Target value for the installed power load

Introducing target values for all factors appearing in the denominator of Equation (1), the maximum electrical power to be installed can be predicted and is the installed power load target value P_T. The key parameter of the criterion is to find the target value for the utilance U_T as a function of common lighting design parameters and taking into account some basic lighting comfort requirements [2-3].

In order to trace the most inefficient lighting installations, the following minimal target values are proposed (see [2] for extended explanation and theoretical background of U_T):

- $\eta_{sys} > 75$ lm/W
- $LOR > 0,80$
- MF: remains an input param.
- $$U_T = \max\left(\frac{1 + \frac{0.5 \cdot \langle \rho_{TA} \rangle + 0.5 \cdot \langle \rho'_{nTA} \rangle}{1 - \langle \rho_{\infty} \rangle}}{1 + 0.5 \cdot \frac{A_{nTA}}{A_{TA}}} ; 0.5 \right)$$

Herewith, $\langle \rho_{TA} \rangle$ is the weighted mean reflectance of the task areas - $\langle \rho'_{nTA} \rangle$ is the weighted mean reflectance of the non-task areas with exception of the ceiling - $\langle \rho_{\infty} \rangle$ is the weighted mean reflectance of all room areas - A_{TA} is the total task area and A_{nTA} is the total non-task area.

Finally, the target value for the power load P_T can be formulated as:

$$P_T = \frac{\sum_i \bar{E}_{TA,i}^{fin} \cdot A_{TA,i}}{MF \cdot U_T \cdot 80 \cdot 0,75} \quad (2)$$

At the request of the Flemish Energy Agency, the target value P_T, Equation (2), is more stringent for offices than for other applications (non-offices). For office rooms, η_{sys} and *LOR* are 85 lm/W and 0,85 instead of 75 lm/W and 0,80, respectively.

2.4 Required input parameters

The input parameters required to calculate the target value for the installed power load P_T are:

- A list of all task areas and specifications: the surface areas, type of the task area(s) - type a, type b or type c as explained in section 2.2 - and the maintained mean illuminance values (as obtained output by light planning software).
- Surface areas and reflectance of walls, ceiling, floor and *type c* task areas.
- The maintenance factor used in the light planning software to compute the maintained illuminance values.

With these data, the target value P_T can be calculated using a spreadsheet (with implementation of Equation (2)) and is compared to the installed power load P_{inst}, obtained by light planning software. Installations which do not fulfill the condition

for P_T can certainly be classified as inefficient.

The criterion is suitable for any interior task areas and is valid for a wide range of applications as may occur in offices, shops, storehouses, work areas, classrooms, etc. In [2] and in section 4, two examples illustrate the validity of the criterion. In a first example, it is shown that target values obtained for standard task areas (i.e. reference plane parallel with the floor) converge to actual target values in current practice. In a second example, a store with a lot of vertical task areas has been considered. Even with an energy efficient lighting solution and a good lighting design, it was previously nearly impossible to meet the former *NPD* requirement which is for this example completely irrelevant. With the new evaluation method, good lighting designs for non-standard task areas can pass the selection criterion and get a subsidy.

3. AMOUNT OF THE SUBSIDY AND ADDITIONAL REQUIREMENTS

The amount of subsidy and additional requirements to get grants for re-lighting and new-lighting in Flanders are listed[1]. This is valid in Flanders since January 2010.

- Amount of the subsidy:

$$€\ 100 \cdot \left(2 - \frac{P_{inst}}{P_T} \right) \cdot P_T \cdot 1{,}5 \quad (3)$$

  - With P_T according to Equation (2). In Equation (3), the power is expressed in *kW*
  - The condition $P_{inst} \leq P_T$ has to be fulfilled. For office rooms, the condition is about 20% lower (see section 2.3).
  - The grant is limited to € 15.000
  - Additional requirements:
    - The use of white painted luminaires is not allowed
    - A lighting study (using light planning software) is required
    - A list of surfaces of the room
    - A list of task areas
    - The completed spreadsheet (in order to calculate P_T)
    - Brand and specifications of all luminaires and lamps
    - Specifications of the new installation (P_{inst} and annual burning hours)

[1] The requirements for newlighting are similar

4. PRACTICAL EXAMPLES

4.1. Small office room

In a first validation, the new evaluation method has been applied to a small office. An office is a typical example of a standard task area where the task area is parallel with and (approximately) equal to the floor area.

We consider an office of 10.55 *m* by 8.34 *m* with a height of 3.05 *m* (Figure 1). The reflectances of the ceiling, walls and floor are 70%, 40% and 20%, respectively.

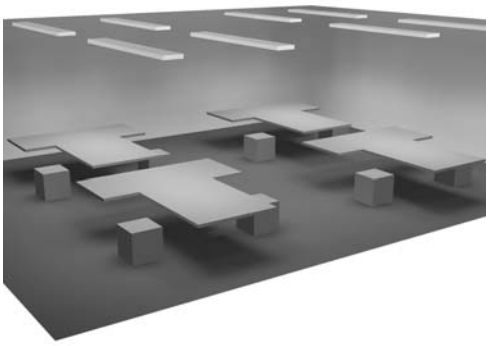

Figure 1. 3D view of the office room

In this case, the working plane is at 0,75 *m* above the floor; no wall zone was used in the light planning software. The task area is a transparent calculation surface parallel with the floor. Hence, the task area is of *type a* with a surface area equal to the floor area (88 m²). With a *MF* of 0,85, the maintained mean illuminance value on the task area is 640 *lx* with an installed power load of 1006 *W*.

To evaluate the energy efficiency of the lighting installation, the target value P_T for offices has been calculated and equals 1287 *W*. As the installed power load P_{inst} is lower than the target value P_T , the lighting installation can be classified as energy efficient and can be considered for grant. In case of a relighting, the subsidy is € 235, according to Equation (3).

4.2. Storehouse

In a second example, we consider a typical application where the task areas are completely different from the floor area.

A relighting of a store with 36 racks as described in [2] has been studied. A 3D view is shown in Figure 2. The length, width and height of the storehouse are 127.84 *m*, 65 *m* and 11 *m*, respectively. All racks are 45 m long and 7.2 *m* high. In addition, there are two load areas transversal to the racks (Figure 2). The installed power load P_{inst} is 64 *kW*.

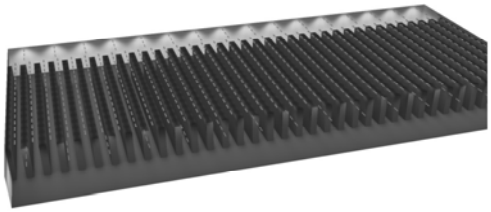

Figure 2. 3D view of the storehouse

In order to calculate the power load target value with the new evaluation method, the task areas have to be defined. The designer has defined three different task areas: both load areas and all racks. Both load areas are *type a* task areas (joint surface area of about 5800 m²) while the racks are of *type c* (vertical surfaces which are part of additional furniture with a joint surface area of about 23300 m²). The reflectances of the ceiling, walls, floor and racks are 50%, 30%, 10% and 10%, respectively. Illuminance values are calculated with DIALux [4] and using (2) one finds the target value P_T of 76,7 *kW*. As the installed power load is 17% lower than the target value, the lighting installation of the storehouse can be classified as energy efficient and, hence, can be considered for grant. The normalized power density value referenced to the floor –which is completely irrelevant – is 2,58 *W*/(m²·100 lx). In the past, this store should not be considered for grant because the value is higher than 2,50 *W*/(m²·100 lx). More details of this practical case can be found in [2].

The grant for relighting this store can be calculated using Equation 3 and is € 13.400 if all other conditions (Section 3) are met.

5. CONCLUSIONS

To reduce the electrical power consumption of indoor lighting installations, the Flemish Energy Agency provides grants for re- and newlighting to companies, institutions and local authorities which realize energy efficient lighting solutions.

Until the end of 2009, the maximum *NPD* value to be considered for grant allocation was 2 *W*/(m²·100 lx) for offices and industrial buildings and 2,5 *W*/(m²·100 lx) for sports halls and swimming pools. This criterion was appropriate for areas where a uniform illuminance was required over a task area approximately equal to or parallel with the floor (for instance open plan offices). However, it is obvious that in shops, storehouses, classrooms and many other situations, the task areas can be completely different from the floor area and a lot of energy efficient lighting solutions were not considered for grant.

This has forced the Flemish Energy Agency to revise the conditions for grant allocation. In this paper, the new evaluation criterion has been explained as well as the amount of the subsidy and additional requirements. Some practical examples illustrate the new approach, which is in force since January 2010.

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